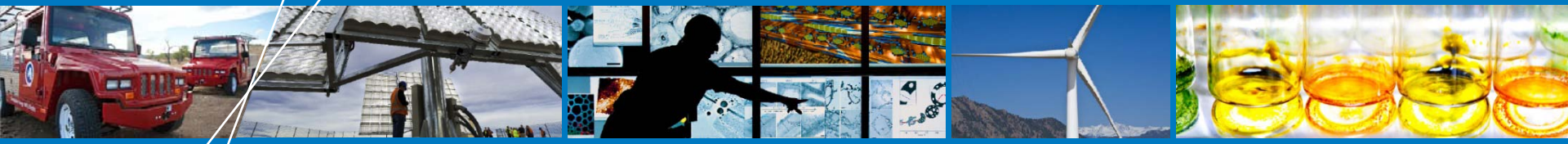
NREL
NATIONAL RENEWABLE ENERGY LABORATORY



Energy Systems Integration Facility

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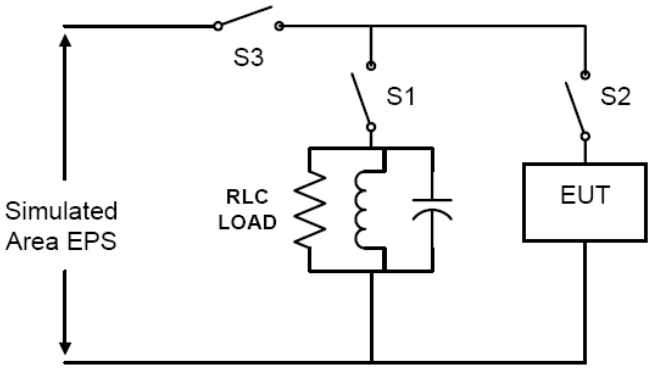
ESIF Example – Solar Industry Support

- Inverter manufacturers are building larger PV inverters to reduce large system costs
- Interconnection testing is needed to certify equipment at 1MW+ sizes
- Full ESIF build out will allow testing at these levels and allow for quick experimental setup
- ESIF will allow low cost testing and evaluation of large-scale equipment with minimum set-up time

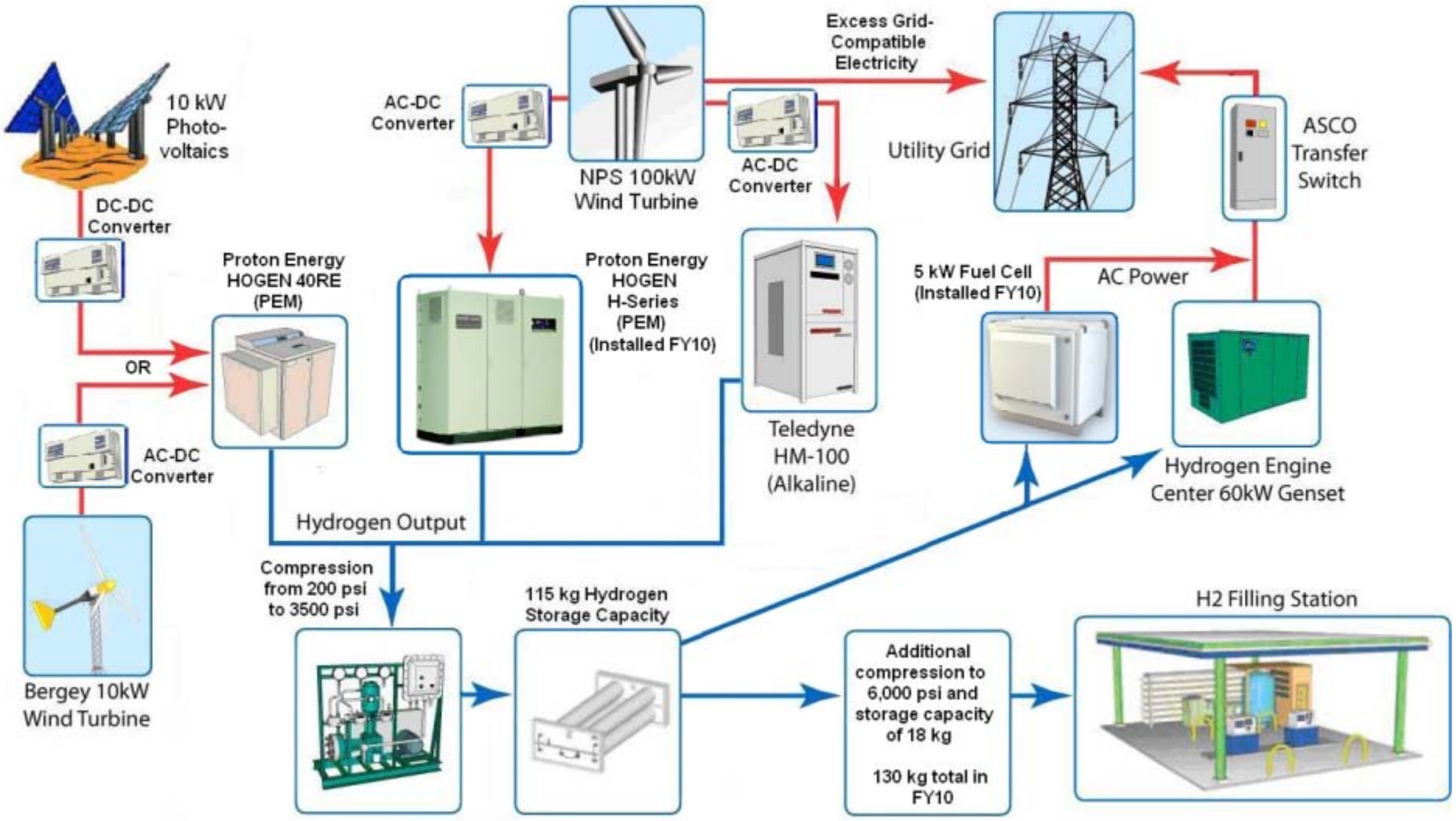


IEEE 1547 – Unintentional islanding test
Equipment needs: large RLC load, equipment under test (EUT) power supply, large grid simulator or grid connection

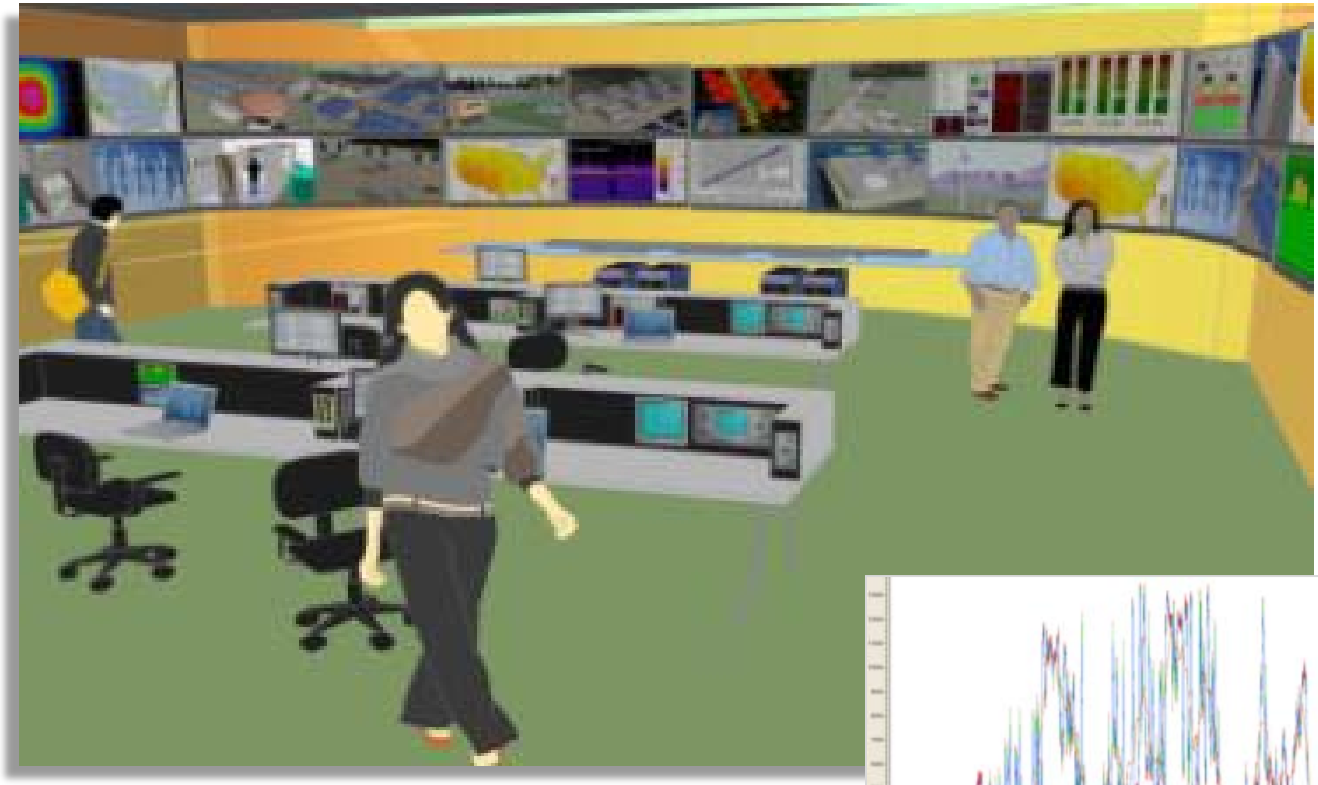
ESIF Example – Utility/Industry Support

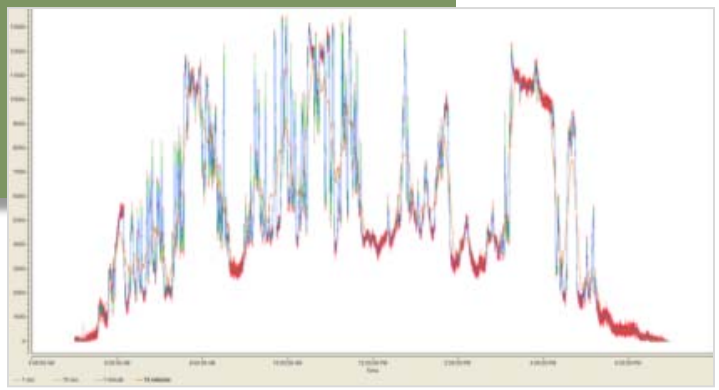
- Portland General Electric (PGE) is developing an inverter-battery (1 MW - 240 kWh) at NREL before installation of a full size testing and demonstration of the 5 MW - 1200 kWH rated device
- Tests will include both grid connected and isolated operations
- With the scaled fully functional NREL testing at the MW level, PGE will be substantially better prepared to carry out full rated system testing under an array of varying conditions on our distribution feeder

ESIF Example – Hydrogen Systems Integration



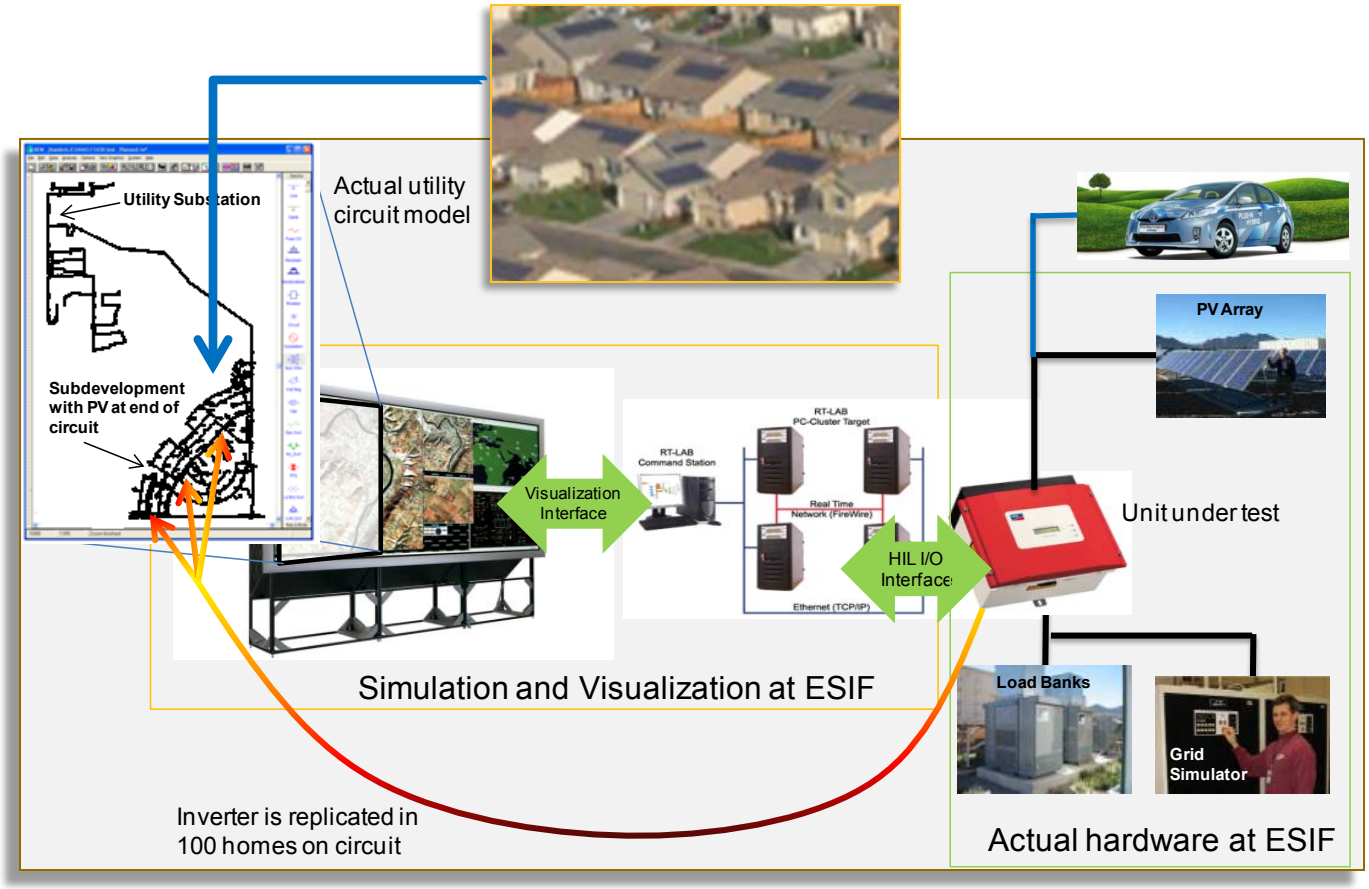
Electrical Visualization





Power Hardware- and Systems-in-the-Loop

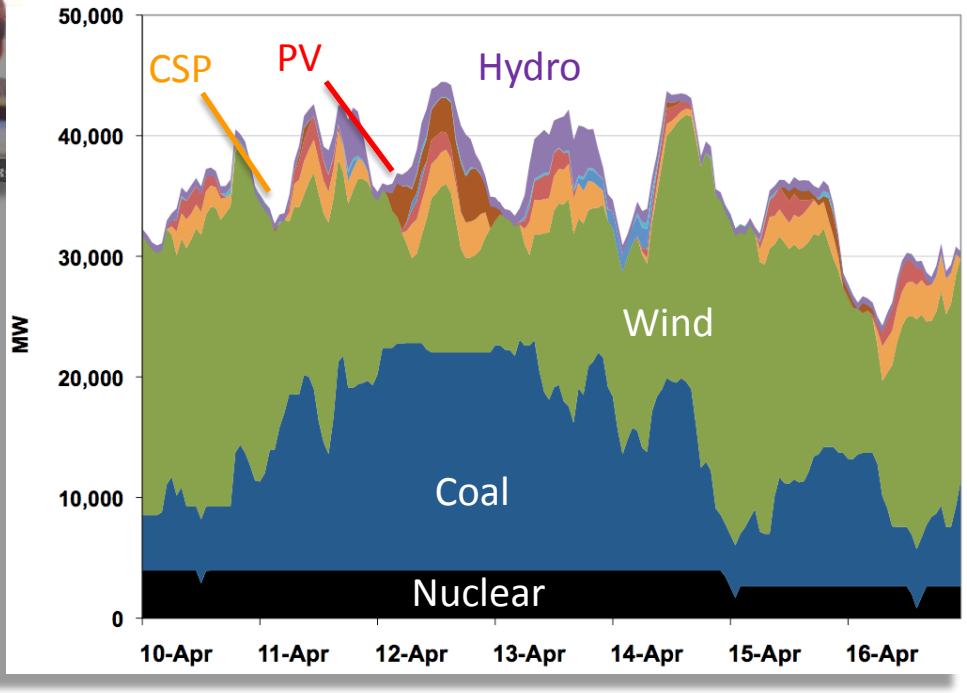
- State of the art electric systems simulation and visualization in an HPC environment
- Component and systems testing and validation at MW-scale powers
- Integration of functioning systems with utility system simulations for real-time, real-power evaluation of high penetration scenarios



Evaluation of large-scale deployments of distributed systems

Bulk Power System Simulated Operations

A Flight Simulator for Utility Operators



Operations techniques development for:

- New systems configurations
- High renewables penetrations
- Extreme weather events
- High storage penetrations
- High demand response deployment
- Resource forecast integration

Energy Systems Integration Facility (ESIF)

A unique national asset for energy systems integration R&D, testing, and analysis.